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SUMMARY OF A WATER QUALITY SURVEY, GREELEY, COLORADO

NOVEMBER 16-19, 1971

ENVIRONMENTAL PROTECTION AGENCY

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I. Introduction

A water quality survey was conducted on the Cache La Poudre River and on selected waste discharges in the Greeley, Colorado, area during the period from November 16 to November 18, 1971. The purpose of the survey was to assess the effect of Great Western's sugar factory on the Cache La Poudre River and to determine the characteristics of the waste discharged from this plant. Because of the close proximity of Great Western's factory to the Greeley wastewater treatment facility, and because of other possible sources of wastes (i.e. feedlots) in the area, the water quality survey included the entire Greeley area.

II. Description of the Area

The Cache La Poudre River flows through portions of the City of Greeley and is bounded by agricultural lands, marshy areas, gravel pits, feed lots, a city park, residential areas, junk yards, a packing plant, a livestock truck washing operation, a sugar beet factory, a wastewater treatment facility, etc. This development that has taken place on the flood plain provides a high potential for waste materials to enter the river during periods of runoff. There are, however, only a limited number of direct discharges to the river. In addition to the discharge from the Greeley wastewater facility and the two discharges from Great Western's factory, there were observed several small drainage ditches, which appeared to be carrying surface water, and several storm sewer outfalls. Only two discharges were sampled during the water quality survey: the effluent from the Greeley wastewater treatment facility and the spent flume water from Great Western's factory.

The Greeley wastewater treatment facility consists of an old and a new plant located immediately adjacent to each other. The older plant is a trickling filter facility which had not been in operation for several months. Prior to discontinuing use of the filters, the facility was used to treat the wastes from the large packing plant located in Greeley. Future plans are to abandon the filters completely and treat the packing house wastes at a new facility to be constructed east of Greeley. In the meantime the filters were scheduled to be placed back into operation during the first part of December 1971.

The new plant uses the activated sludge process to provide secondary treatment. This plant was originally designed to treat only the domestic wastes from the City of Greeley. During the survey, this plant was receiving both the domestic and packing house wastes which was severely overloading the facility, resulting in a very poor quality effluent.

The final effluent is chlorinated prior to discharge to the Cache La Poudre River. A low head dam has been built on the river to provide sufficient water elevation for an intake to the Great Western Sugar factory. The effluent from the Greeley wastewater treatment plant discharges immediately downstream of this dam.

Two discharges from the Great Western Sugar factory were observed during the water quality survey. The smaller of the discharges is apparently the excess condensor water from the factory. This effluent is relatively clear, has a high temperature as evidenced by the steam, has a relatively small flow and does not continuously discharge.

The other effluent from the Great Western factory consists, for the most part, of spent flume water. This water is passed through a "serpentine" ditch to allow for some settling of solids and is then discharged directly to the Cache La Poudre River. The effluent to the river is black in color, has a noticeable high solids content, and gives off an odor characteristic of septic wastes. The black effluent hugs the south bank of the river for several hundred feet downstream of the outfall.

The excess condensor water effluent discharges to the river adjacent to the Greeley wastewater treatment plant and the flume water discharges approximately one-half mile downstream of this location.

III. Applicable Water Quality Criteria

A summary of water quality standards that apply to the Cache La Poudre River in the vicinity of Greeley, as well as those portions of the Rivers and Harbors Act of 1899, that apply to the Great Western Sugar Company's refinery at Greeley are summarized briefly below.

As of June 10, 1970, the classification of the lower reaches of the Cache La Poudre River has been C & D_1. This classification of the river is effective for all waters downstream of the Second Avenue Bridge in Greeley, which is just upstream of the Greeley wastewater treatment facility and the discharges from Great Western's refinery. According to the Water Quality Standards for Colorado, the following criteria apply to a C & D_1 stream:

1. Dissolved Oxygen - Not less than 3 mg/1.

2. pH - Maintained between 5.0 and 9.0.

3. Turbidity - Shall not exist in concentrations that will interfere with established levels of treatment.

4. Temperature - Not to exceed 93°F.

5. Total dissolved solids (salt) concentrations and the Sodium Adsorption Ratio computed on a time-weighted monthly mean basis that exceeds the time-weighted monthly mean for a base period by more than two standard deviations shall be subject to review by the Commission.

6. Toxic Material - Free from biocides, toxic, or other deleterious substances attributable to municipal, domestic, industrial wastes, or other controllable sources in concentrations or combinations which are harmful to crop life.

As of September 1, 1971, the State of Colorado set a new stream classification of A,C,D_1 for the Cache La Poudre at Greeley, Colorado. However, there is a question as to the procedure used by Colorado in setting this new stream classification. An "A" classification would include the following criteria:

1. Fecal Coliform - (MPN or mf) Not to exceed a log mean of 1000 per 100 ml, or not to exceed 2000 per 100 ml in more than 10% of the samples collected in any 30-day period.

2. Dissolved oxygen - Greater than 4.0 mg/1.

3. pH - Maintained between 6.0 and 9.0.

4. Free from taste and odor-producing materials.

5. Total dissolved solids - Computed on an annual volume weighted average, not to exceed 500 mg/1.

In addition, Colorado has basic criteria that apply to all waters which include:

1. Waters of the state whose quality exceeds that quality set in the Water Quality Standards shall be maintained at existing quality until it can be demonstrated to the state that a change in quality is justified for economic and social development.

2. All wastes shall receive secondary treatment with disinfection or its industrial equivalent unless it can be demonstrated that the standards applicable to the classified water can be attained with a lesser degree of treatment.

3. All waters shall be free from municipal, domestic, or industrial wastes that will produce objectionable odor, color, taste, turbidity, objectionable aquatic life; or that will settle to form unsightly putrescent or odorous bottom deposits; or that will contribute unsightly floating debris, oil, grease, scum, or other floating material; and be free from high temperatures, biocides, toxic, or other deleterious substances sufficient to be harmful to human or animal life.

For purposes of enforcement of water classification standards, sampling of the waters shall be done at any point, except for areas immediately adjacent to outfalls.

In addition to the water quality standards the discharge from Great Western is controlled by the Refuse Act as outlined below:

"According to the Rivers and Harbors Act of 1899, it shall be unlawful to discharge or deposit from a manufacturing establishment or mill of any kind, any refuse matter of any kind or description, into any navigable water of the United States, or any tributary of any navigable water from which the same shall float or be washed into such navigable water. It is provided further that the Secretary of the Army, whenever in the judgment of the Chief of Engineers, anchorage and navigation will not be injured thereby, may permit the deposit of any material within limits, provided application is made to him prior to depositing such material; and whenever any permit is so granted, the conditions thereof shall be strictly complied with, and any violation is unlawful."

Great Western Sugar Company of Greeley, Colorado, has filed for a discharge permit. However, the permit section does not feel that a permit can be issued to Great Western until their method of waste water treatment has been improved.

1. August, 1969 - Final plans for implementation due (date set in Colorado Water Quality Implementation Plan).

2. December, 1970 - Abatement date (set in the Colorado Water Quality Implementation Plan).

3. June, 1971 - Compliance date (set at the South Platte Enforcement Conference, November 10, 1966.)

Since the Enforcement Conference (1966), the only additions to the waste treatment at Greeley have been a serpentine ditch and a vibrating screen for the flume, wash, and condensor water discharge.

IV. Survey Methods

Nine stations were selected for sampling on the Cache La Poudre River. Station locations and descriptions are outlined in Table 1, and station locations are depicted in Figure 1. In addition to the river stations, samples were also taken of the Greeley wastewater treatment facility effluent, and of Great Western Sugar Company's influent, factory effluent and discharge to the Cache La Poudre River.

To determine what variations might occur over a 24-hour period, three eight-hour intervals were selected for composite sampling. Four uniformly sized samples were to be collected and composited from each station on a bi-hourly basis. However, the distance between stations and the number of stations made bi-hourly sampling difficult, and the first compository period extended beyond the eight-hour interval. The first sampling period was from 4:00 p.m., until 3:15 a.m., on November 16, 17, 1971. The second sampling period was from 8:00 a.m., until 3:30 p.m., on November 17, 1971. The third sampling interval was scheduled for 12:00 midnight to 8:00 a.m., on November 18, 1971; however, no samples were collected.

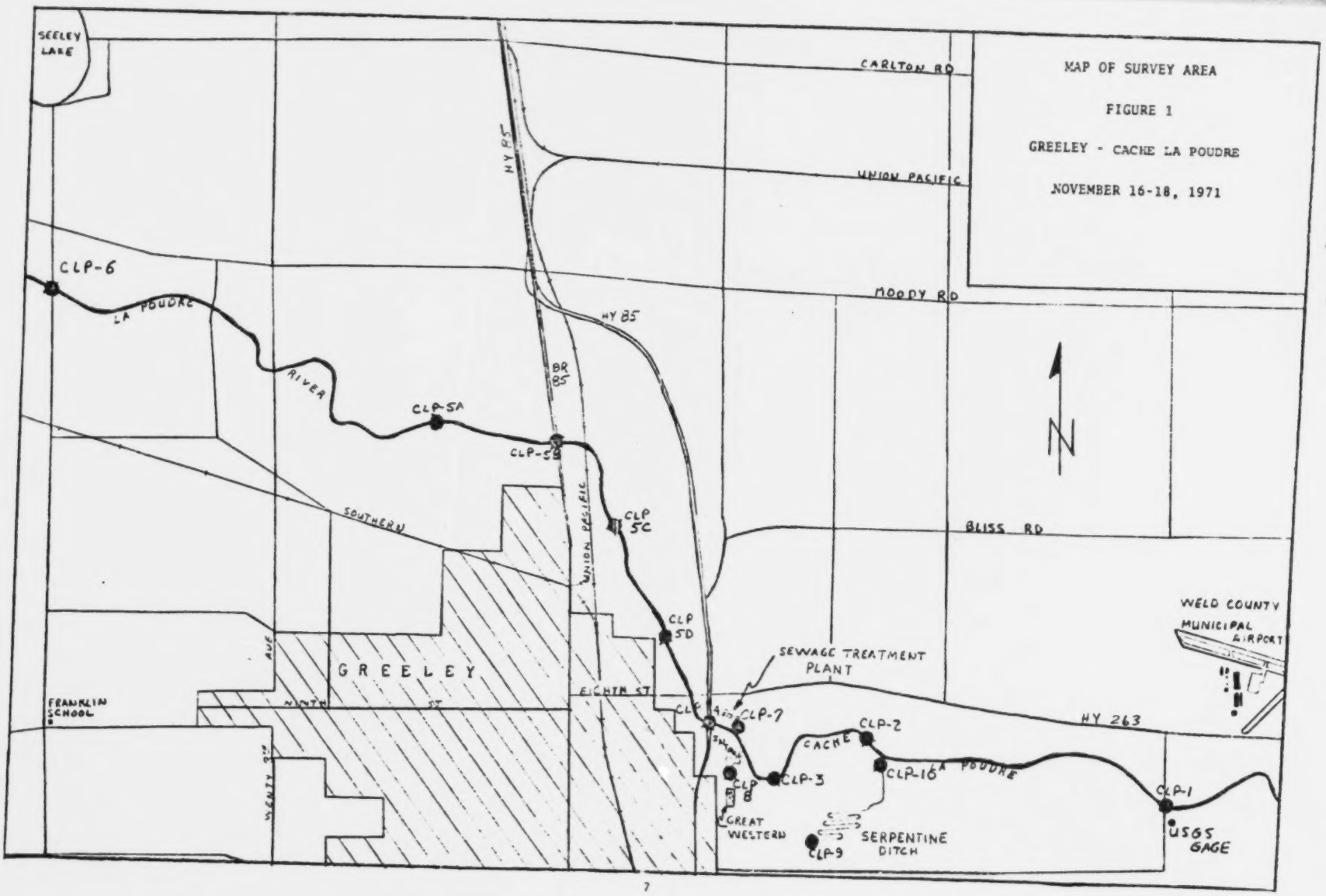
Field measurements of pH, dissolved oxygen, and temperature were determined on the majority of grab samples collected. All laboratory analyses, except coliform determinations, were made by the EPA Region VIII laboratory. Coliform determinations were made by the Colorado State Department of Health.

Previous state data from the Cache La Poudre in the Greeley area indicated that coliform contamination was occurring upstream of the Second Avenue Bridge (CLP-4), and downstream of sampling station CLP-6 (see Figure 1). An attempt to "bracket" this suspected bacterial pollution was made by collecting grab samples for bacterial analysis only at stations 5A, B, C, and D. Grab samples for bacteriological analyses were collected from the other sampling stations on November 16, 17, 18, 1971.

In addition to the composite sampling and grab sampling, a dissolved oxygen profile was run on a portion of the river on November 18, 1971. The profile was run on stations downstream of Greeley and Great Western's factory. The profile extended to the confluence of the Cache La Poudre River with the South Platte River.

TABLE I
Station Locations and Descriptions
Greeley - Cache La Poudre Survey
November 16 - 18, 1971

Station Number	Station Description
CLP - 6	Cache La Poudre River at bridge south of Seeley Lake.
CLP - 5A	Cache La Poudre River at foot bridge adjacent to Island Grove Park.
CLP - 5B	Cache La Poudre River at 8th Avenue Bridge.
CLP - 5C	Cache La Poudre River at 6th Avenue Bridge.
CLP - 5D	Cache La Poudre River at 5th Street Bridge.
CLP - 4	Cache La Poudre River at 2nd Avenue Bridge.
CLP - 3	Cache La Poudre River at first bridge downstream of lowhead dam.
CLP - 2	Cache La Poudre immediately upstream of Great Western's "serpentine ditch" discharge (south bank).
CLP - 1	Cache La Poudre River at bridge south of airport (USGS GAGE).
CLP - 7	Greeley Wastewater Treatment Facility chlorinated effluent.
CLP - 8	Great Western Sugar Company's water supply intake (source - Cache La Poudre River).
CLP - 9	Great Western Sugar Company's factory effluent.
CLP - 10	Great Western Sugar Company's effluent to Cache La Poudre River.


SEELEY LAKE
CARLTON RD
UNION PACIFIC
HY 85
MOODY RD
CLP-6
LA POUDRE
RIVER
CLP-5A
CLP-5B
BR 85
CLP 5C
SOUTHERN
UNION PACIFIC
BLISS RD
CLP 5D
WELD COUNTY MUNICIPAL AIRPORT
SEWAGE TREATMENT PLANT
GREELEY
FRANKLIN SCHOOL
AVE
NINTH ST
EIGHTH ST
CLP-7
HY 263
CLP-2
CACHE
CLP-3
CLP-16
LA POUDRE
CLP-1
CLP 8
GREAT WESTERN
CLP-9
SERPENTINE DITCH
USGS GAGE
MAP OF SURVEY AREA
FIGURE 1
GREELEY - CACHE LA POUDRE
NOVEMBER 16-18, 1971

V. Analysis of Results

The survey results are selectively presented in the following section. Appendix A - Laboratory Analysis, Appendix B - Field Data, and Appendix C - Microbiological Data, present a complete listing of the survey data. Data in this section are presented for both compositing periods. Compositing Period #1 will designate the data determined from samples collected on November 16-17, 1971, from 4:00 p.m. to 3:00 a.m. Period #2 will designate the data determined from samples collected on November 17, 1971, from 8:30 a.m. to 4:00 p.m.

A. Waste Discharges

1. Greeley Wastewater Treatment Facility

Table 2 presents the effluent data obtained from the Greeley wastewater treatment facility. The high values indicated in the Table emphasize the poor quality of the treated effluent. This poor quality is a direct result of the extremely overloaded condition of the plant. Flow at the plant was not determined for each compositing period and, therefore, loadings to the Cache La Poudre River cannot be calculated. The total flow through the plant on November 16, 1971, was 6.9 million gallons and on November 17 it was 7.0 million gallons. It is anticipated that Greeley's plans to start up the trickling filter portion of their plant will alleviate some of the overloaded condition and show an improvement in the effluent quality.

2. Great Western Sugar Factory

Tables 3 and 4 present the data obtained from the influent and effluent samples collected from the "serpentine ditch" of the Great Western Sugar factory.

Table 3 presents the data on influent and effluent quality as well as percentage reduction of selected parameters for compositing Period 1. Low reductions are indicated since at night the strength of the influent decreases while the effluent reflects the day's load due to the four to eight-hour detention time in the "ditch". Table 4 shows the same information as Table 3 for compositing Period 2. This Table shows increased percentages of reduction; however, the ineptness of the serpentine ditch as a treatment system is well reflected in the poor (low) removal efficiencies.

The waste discharged from the Great Western factory is significantly a higher strength waste than that discharged from the overloaded wastewater treatment facility. (See Tables 2, 3, and 4). The high total suspended solids (TSS) in the Great Western Effluent are capable of causing sludge banks in the Cache La Poudre River. Indeed, sludge

banks may have been present at the time of this survey but they were not observable due to the high turbidity of the water in the river. It is noted in Tables 3 and 4 that the volatile suspended solids (VSS) are only a small percentage (less than 25%) of the TSS. This reflects the "mud" characteristics of the beet flume or transport water.

The rapid depletion of dissolved oxygen (from greater than 4 to 0 in the four to eight hours detention time in the serpentine ditch) indicates the rapid oxygen uptake rate for the sugar waste.

Table 2
Laboratory Results - Greeley Wastewater Treatment Plant
Greeley - Cache La Poudre Survey
November 16-18, 1971

	BOD_5 mg/l	TSS mg/l	VSS mg/l	Total Carbon mg/l	Turb. JTU	D.O.* mg/l
Period 1	145	194	104	108	94	2.60
Period 2	177	108	84	116	90	2.15

*Average of grab samples

Table 3
Laboratory Results - Great Western - Period 1
Greeley - Cache La Poudre Survey
November 16-18, 1971

Station	BOD_5 mg/l	TSS mg/l	VSS mg/l	Total Carbon mg/l	Turb. JTU	D.O.* mg/l
CLP-9 (Inf.)	345	1908	252	126	720	4.15
CLP-10 (Eff.)	465	1556	260	146	560	0.00
% Reduction	0	18.5	0	0	22.2	-

*Average of grab samples

Table 4
Laboratory Results - Great Western - Period 2
Greeley - Cache La Poudre Survey
November 16-18, 1971

Station	BOD_5 mg/l	TSS mg/l	VSS mg/l	Total Carbon mg/l	Turb. JTU	D.O.* mg/l
CLP-9 (Inf.)	555	1168	232	231	500	4.12
CLP-10 (Eff.)	315	992	204	148	400	0.00
% Reduction	43.3	15.1	12.1	35.9	20.0	--

*Average of grab samples

Tables 3 and 4 indicate that Great Western was discharging an effluent containing waste materials that could be classified as refuse.

B. River Stations

A summary of selected water quality parameters for the composited river stations is shown in Table 5 (Period 1) and Table 6 (Period 2). A trend can be established from this data. In all cases the water quality, as indicated by the selected parameters, decreased as it progressed downstream. The decrease in water quality ties in directly with the two major waste discharges.

Station CLP-4 was located in the backwater of the low head dam and the data suggests that this pond was behaving as a lagoon, causing a reduction in BOD_5 and an increase in solids and turbidity due to biological growth.

The conclusion that can be drawn from the data presented in Tables 5 and 6 is that the waste discharges from the Greeley wastewater treatment plant and Great Western's sugar refinery did cause an impact on the water quality in the Cache La Poudre River and degraded this quality to the degree indicated by the values in the Tables.

Tables 7 and 8 indicate the dissolved oxygen values obtained during each compositing period. The dissolved oxygen concentration decreased progressively in the downstream direction.

Table 5
River Stations - Selected Parameters - Period 1
Greeley - Cache La Poudre Survey
November 16-18, 1971

Station		BOD_5 mg/1	TSS mg/1	VSS mg/1	Total Carbon mg/1	Turb. JTU
CLP-6		6	66	5	52	15
CLP-4		1	108	11	56	23
Greeley Eff. →						
CLP-3	Downstream	11	97	9	59	17
CLP-2		19	114	17	61	19
Great Western Eff.→						
CLP-1	↓	28	101	28	63	26

Table 6
River Stations - Selected Parameters - Period 2
Greeley - Cache La Poudre Survey
November 16-18, 1971

Station		BOD_5 mg/1	TSS mg/1	VSS mg/1	Total Carbon mg/1	Turb. JTU
CLP-6		5	25	3	46	7
CLP-4		3	50	5	53	15
Greeley Eff. →						
CLP-3	Downstream	13	119	34	50	19
CLP-2		15	80	15	56	21
Great Western Eff.→						
CLP-1	↓	13	87	15	56	24

Table 7
River Stations - Dissolved Oxygen - Period 1
Greeley - Cache La Poudre Survey
November 16-18, 1971

Station	D.O.* mg/1	Temp** °C	D.O. Saturation mg/1	Δ D.O. mg/1
CLP-6	9.2	5.5	12.6	3.4
CLP-4	8.2	6.2	12.4	4.2
Greeley Eff. →				
CLP-3	9.0	6.9	12.2	3.2
CLP-2	8.8	7.5	12.0	3.2
Great Western Eff. →				
CLP-1	7.9	7.5	12.0	4.1

Downstream ↓

*Average of two grab samples.
**Average of four determinations.

Table 8
River Stations - Dissolved Oxygen - Period 2
Greeley - Cache La Poudre Survey
November 16-18, 1971

Station	D.O.* mg/1	Temp** °C	D.O. Saturation mg/1	Δ D.O. mg/1
CLP-6	10.2	4.3	13.0	2.8
CLP-4	9.6	4.7	12.9	3.3
Greeley Eff. →				
CLP-3	9.2	5.2	12.7	3.5
CLP-2	9.0	5.7	12.6	3.6
Great Western Eff. →				
CLP-1	7.8	5.1	12.8	5.0

Downstream ↓

*Average of two grab samples.
**Average of four determinations.

As above, the results at station CLP-4 can be explained by the sample being collected in the backwater of a low head dam.

It is shown in Tables 7 and 8 that the depression of dissolved oxygen concentration below that of saturation also increased as one progressed downstream. This reflects the impact of the waste discharges. The rapid uptake of oxygen exerted by the sugar refinery waste is evidenced by the larger drop in dissolved oxygen concentration below Great Western's outfall.

It is noted that despite the dissolved oxygen depression, the concentration of dissolved oxygen in the stream did not fall below the 3.0 mg/l water quality standard.

C. Sampling Stations - Microbiological

The microbiological data are presented in Table 9. As can be seen in this Table, again there was a degradation of water quality as one progressed downstream.

The coliform concentrations in the chlorinated Greeley wastewater treatment plant effluent (CLP-7) were extremely high. The high solids content of the effluent was apparently interfering with the effectiveness of the chlorination.

Great Western's effluent (CLP-10) also had high coliform concentrations (210,000 to 300,000 MPN per 100 ml).

It is noted that the CLP-5A through 5D stations were used in an attempt to bracket areas of bacterial pollution upstream of the low head dam (CLP-4). The data collected on 11/18/71 for station CLP-5C indicate that an upstream source of bacterial pollution exists. Visual observations were made to try and reveal this source but no conclusions were made. A more detailed study will be required in this stretch of the river.

Below station CLP-4 or the 2nd Avenue bridge no coliform standard exists for the Cache La Poudre River so that the high concentrations observed do not violate water quality standards as they now are established.

D. Dissolved Oxygen Profile

On November 19, 1971, a dissolved oxygen profile was run on the Cache La Poudre River below the Great Western outfall. The sampling station locations are depicted in Figure 2. The data are tabulated in Table 10.

Table 9
Microbiological Data **
Greeley - Cache La Poudre Survey
November 16-18, 1971

Station Number	Station Description	11/16/71	11/17/71	11/18/71
CLP-6	Cache La Poudre Upstream Station	2,400*	2,200	2,200
		150	300	2,200
CLP-5A	Cache La Poudre Adjacent to Island Grove Park	960	-	-
		300	-	-
CLP-5B	Cache La Poudre at 8th Avenue Bridge	2,400	2,200	-
		300	150	-
CLP-5C	Cache La Poudre at 6th Avenue Bridge	-	2,400	22,000
		-	300	22,000
CLP-5D	Cache La Poudre at 5th Street Bridge	-	-	22,000
		-	-	220
CLP-4	Cache La Poudre at 2nd Avenue Bridge	220,000	240,000	220,000
		2,200	2,200	5,000
CLP-7	Greeley S.T.P. Chlorinated Effluent	22,000,000	2,400,000	2,200,000
		22,000	22,000	22,000
CLP-3	Cache La Poudre at First Bridge Downstream of Greeley S.T.P. Eff.	2,400,000	150,000	220,000
		2,400,000	22,000	220,000
CLP-2	Cache La Poudre Upstream of Great Western Effluent (Bank)	2,200,000	88,000	220,000
		300,000	22,000	220,000
CLP-8	Great Western's Water Intake from Cache La Poudre River	2,200	2,200	24,000
		300	300	1,500
CLP-10	Effluent from Great Western Sugar Plant	2,200,000	2,200,000	22,000,000
		300,000	210,000	300,000
CLP-1	Downstream Station on Cache La Poudre Near USGS Gage	2,200,000	300,000	220,000
		2,200,000	50,000	22,000

* Values in Table are presented with total coliform counts (MPN) on top and fecal coliform counts (MPN) on the bottom.

** Values determined by the Colorado Department of Health.

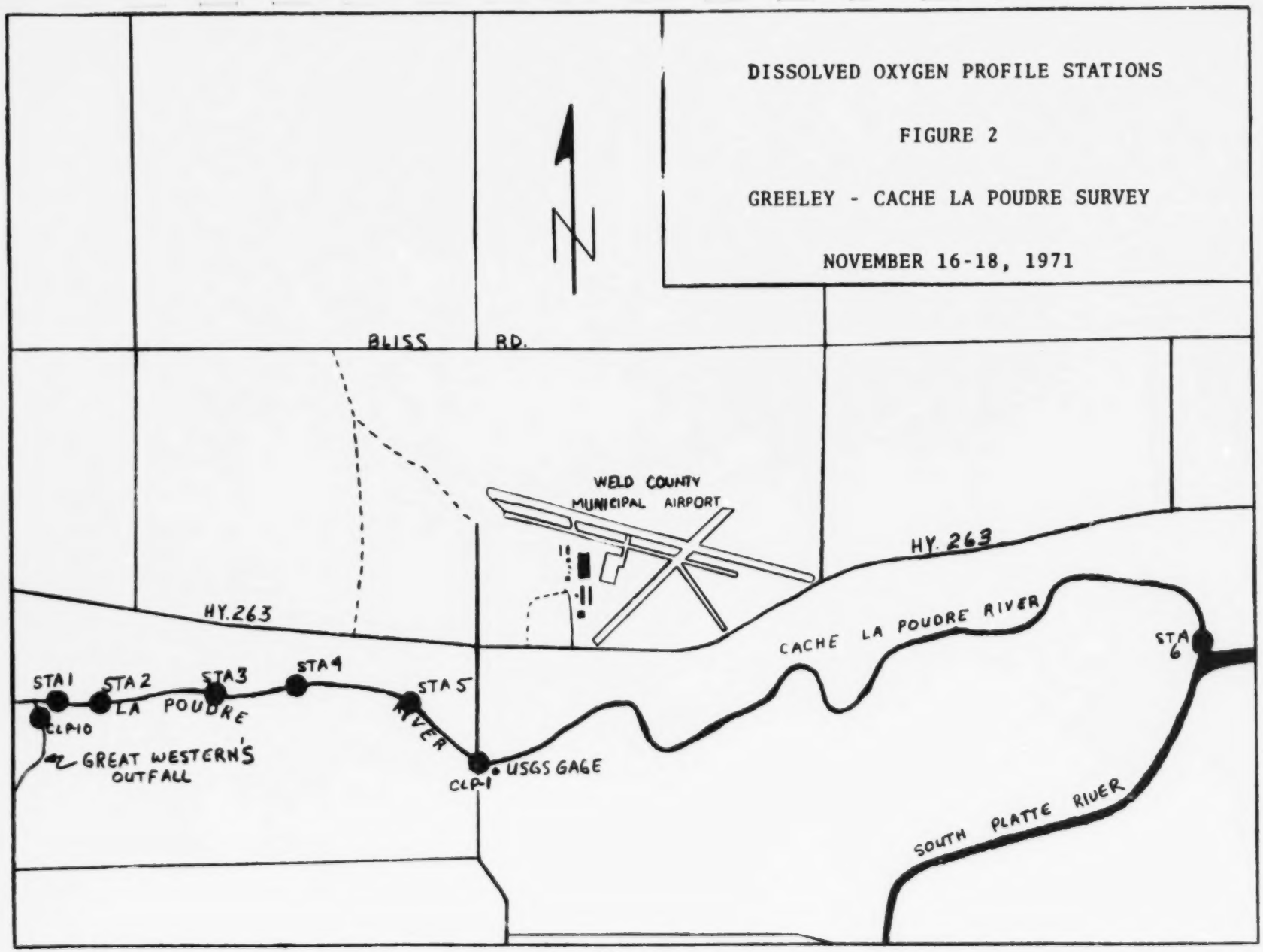

DISSOLVED OXYGEN PROFILE STATIONS
FIGURE 2
GREELEY - CACHE LA POUDRE SURVEY
NOVEMBER 16-18, 1971
BLISS RD.
WELD COUNTY MUNICIPAL AIRPORT
HY. 263
HY. 263
CACHE LA POUDRE RIVER
STA 1
STA 2
STA 3
STA 4
STA 5
STA 6
LA POUDRE RIVER
CLP10
GREAT WESTERN'S OUTFALL
CLP-1
USGS GAGE
SOUTH PLATTE RIVER

Table 10
Dissolved Oxygen Profile Data
Greeley - Cache La Poudre Survey
November 19, 1971

Station		D.O. mg/l	Temp °C	D.O. Saturation mg/l	D.O. mg/l
1	NS*	9.9	4.9	12.8	2.9
	SS**	8.1	9.0	11.6	3.5
2	NS	10.0	4.2	13.1	3.1
	SS	7.1	8.0	11.9	4.8
3	NS	9.5	4.5	13.0	3.5
	SS	8.5	4.5	13.0	4.5
4	NS	8.9	4.5	13.0	4.1
	SS	8.8	4.5	13.0	4.2
5	NS	8.8	4.9	12.8	4.0
	SS	8.7	4.9	12.8	4.1
6	NS	6.2	6.0	12.5	6.3
	SS	6.2	6.0	12.5	6.3

Downstream ↓

* Northside of River at North Quarter Point

** Southside of River at South Quarter Point

As can be seen by the differences in dissolved oxygen concentrations for stations 1, 2, and 3, the effluent from the Great Western factory stayed on the south side of the river. The data also indicate that downstream of station 3 the contents in the river were completely mixed.

As the flow progressed downstream the depression of dissolved oxygen concentration below that of saturation increased to 6.3 mg/l at the confluence of the Cache La Poudre with the Platte River. Although this represents a significant reduction in dissolved oxygen concentration, the standard of 3 mg/l was not violated.

It is noted that the depression of dissolved oxygen concentration is due to the combination of wastes from Great Western and Greeley.

VI. Summary and Conclusions

The results of the survey and the observations made are summarized below:

1. The Greeley wastewater treatment facility was overloaded and was not producing a satisfactory effluent. The start-up of the old (trickling filter) portion of the plant may alleviate a portion of this overloaded condition.

2. The Great Western Sugar Refinery was discharging high strength waste that had received a minimal amount of treatment.

3. The waste discharges from the Greeley wastewater treatment facility and Great Western's factory had an adverse effect on the water quality of the Cache La Poudre River. Chemical parameters, microbiological parameters, and dissolved oxygen concentrations all indicated the adverse impact on river water quality.

4. Despite the adverse effects of the waste discharges from Greeley and Great Western, existing water quality standards were not violated.

5. Coliform contamination was indicated upstream of the Greeley and Great Western discharges.

6. The discharge from Great Western's factory may be considered as refuse matter and, therefore, they are in violation of the Rivers and Harbors Act of 1899.

VII. Recommendations

1. The loading on the Greeley wastewater treatment facility must be reduced either through use of the old plant or plant expansion so that the plant can perform in a satisfactory manner and reduce the pollutional load to the Cache La Poudre River.

2. Great Western must provide wastewater treatment facilities at its Greeley factory in order to provide an effluent that will be suitable for discharge to the Cache La Poudre River.

3. Further investigations should be made in the Greeley area to determine the sources of bacterial pollution that apparently exist upstream of Greeley's and Great Western's discharge.

APPENDIX A

LABORATORY ANALYSIS

Table A-1
Laboratory Data - First Compositing Period
Greeley - Cache La Poudre Survey
November 16-18, 1971

Parameter / Station	BOD_5	DO	pH	Conductivity M-MHOS CM	Turbidity JTU	Alkalinity mg/l as $CaCO_3$	Chlorides mg/L Cl	Total Carbon	Total Inorg. Carbon	Total Dissolved Solids mg/L	Total Suspended Solids mg/L	Volatile Suspended Solids mg/L
CLP-1	28	7.70 8.05	6.50	1508	26	242	-	63	57	1035	101	28
CLP-2	19	8.90 8.75	6.40	1508	19	241	-	61	57	999	114	17
CLP-3	11	8.95 9.10	6.40	1479	17	228	-	59	55	985	97	9
CLP-4	1	9.10 7.40	6.40	1531	23	229	-	56	53	1030	108	11
CLP-6	6	9.05 9.35	6.50	1380	15	211	-	52	52	888	66	5
CLP-7	145	2.60 2.60	6.50	939	94	253	-	108	71	513	194	104
CLP-8	8	9.40 8.95	6.55	1479	9	232	-	56	54	966	56	1
CLP-9	345	4.15 4.15	6.80	1380	720	441	-	126	98	705	1908	252
CLP-10	465	0.00 0.00	6.70	1479	560	556	-	146	114	910	1556	260

Table A-2
Laboratory Data - Second Compsiting Period
Greeley - Cache La Poudre Survey
November 16-18, 1971

Parameter / Station	BOD_5	DO	pH	Conductivity M-MHOS CM	Turbidity JTU	Alkalinity mg/l as $CaCO_3$	Chlorides mg/L Cl	Total Carbon	Total Inorg. Carbon	Total Dissolved Solids mg/L	Total Suspended Solids mg/L	Volatile Suspended Solids mg/L
CLP-1	13	7.70 8.00	6.50	1450	24	241	20	64	56	1034	87	15
CLP-2	15	8.80 9.30	6.35	1479	21	240	23	66	56	1031	80	15
CLP-3	13	8.75 9.75	6.00	1363	19	211	21	70	50	917	119	34
CLP-4	3	9.65	6.20	1508	15	225	17	57	53	1040	50	5
CLP-6	5	10.25	6.30	1392	7	210	17	53	46	921	25	3
CLP-7	177	2.15	6.30	986	90	268	18	116	78	664	108	84
CLP-8	0	8.60 8.20	6.65	1479	8	239	20	60	53	1016	19	0
CLP-9	555	4.05 4.20	6.20	1479	500	335		231	104	1056	1168	232
CLP-10	315	0.00 0.00	6.30	1508	400	457		148	108	943	992	204

APPENDIX B

FIELD DATA

Table B-1
Field Data - First Compositing Period
Greeley - Cache La Poudre Survey
November 16-18, 1971

Station Number	Time	Temp °F	Field pH	Probe D.O. mg/l	Remarks
	4:00 P.M.	43	6.05	8.6	Grab for Lab D.O.
CLP-1	8:25 P.M.	46	6.4	9.3	
	10:17 P.M.	46	-	8.0	
	12:06 A.M.	47	6.0	8.2	Grab for Lab D.O.
	5:55 P.M.	46	7.6	7.5	Grab for Lab D.O.
CLP-2	4:25 P.M.	45	-	7.2	
	10:52 P.M.	46	-	6.8	
	1:21 A.M.	45	6.7	8.7	Grab for Lab D.O.
	6:25 P.M.	46	6.5	7.8	Grab for Lab D.O.
CLP-3	9:40 P.M.	45	-	8.1	
	11:02 P.M.	44	-	7.5	
	1:46 A.M.	44	6.0	10.0	Grab for Lab D.O.
	7:23 P.M.	45	7.0	7.8	Grab for Lab D.O.
CLP-4	10:05 P.M.	44	-	7.9	
	11:33 P.M.	44	-	6.6	
	2:45 A.M.	43	6.2	9.0	Grab for Lab D.O.
	7:55 P.M.	42	8.7	8.2	Grab for Lab D.O.
CLP-6	-	-	-	-	
	-	-	-	-	
	3:14 A.M.	42	6.7	11.0	Grab for Lab D.O.
	7:05 P.M.	60	6.8	3.2	Grab for Lab D.O.
CLP-7	9:55 P.M.	62	-	2.7	
	11:21 P.M.	60	-	2.5	
	2:25 A.M.	60	-	4.0	Grab for Lab D.O.
	6:45 P.M.	45	6.7	7.7	Grab for Lab D.O.
CLP-8	9:47 P.M.	46	-	7.7	
	11:15 P.M.	46	-	6.8	
	2:07 A.M.	45	6.3	8.6	Grab for Lab D.O.
	4:35 P.M.	75	6.5	4.5	Grab for Lab D.O.
CLP-9	8:43 P.M.	84	-	7.0	
	10:31 P.M.	88	-	4.0	
	12:40 A.M.	83	6.5	4.2	Grab for Lab D.O.
	5:35 P.M.	75	6.7	0.4	Grab for Lab D.O.
CLP-10	9:17 P.M.	78	-	0.6	
	10:45 P.M.	78	-	0.7	
	1:00 A.M.	76	6.3	0.5	Grab for Lab D.O.

Table B-2
Field Data - Second Compositing Period
Greeley - Cache La Poudre Survey
November 16-18, 1971

Station Number	Time	Temp °C	Field pH	Probe D.O. mg/l	Remarks
	8:30 A.M.	4.0	6.2	8.7	Grab for Lab D.O.
CLP-1	11:40 A.M.	5.5	6.4	9.2	
	1:15 P.M.	6.0	6.5	9.2	
	2:15 P.M.	5.0	6.9	9.2	Grab for Lab D.O.
	9:40 A.M.	5.0	6.5	10.3	Grab for Lab D.O.
CLP-2	12:05 P.M.	6.0	6.4	10.0	
	1:30 P.M.	6.0	6.4	10.6	
	2:35 P.M.	5.8	-	10.6	Grab for Lab D.O.
	10:20 A.M.	5.0	6.4	10.0	Grab for Lab D.O.
CLP-3	12:15 P.M.	6.0	6.3	9.6	
	1:45 P.M.	5.0	6.2	10.6	
	2:50 P.M.	5.0	-	10.6	Grab for Lab D.O.
	11:00 A.M.	5.0	6.9	11.1	Grab for Lab D.O.
CLP-4	12:35 P.M.	4.5	7.3	10.8	
	2:05 P.M.	4.5	7.4	11.2	
	3:10 P.M.	4.8	-	11.6	
	11:20 A.M.	5.0	-	11.0	Grab for Lab D.O.
CLP-6	12:50 P.M.	4.0	6.8	11.6	
	3:20 P.M.	4.0	-	10.6	
	10:45 A.M.	14.0	6.9	3.8	Grab for Lab D.O.
CLP-7	12:30 P.M.	15.0	6.6	2.8	
	1:55 P.M.	15.0	7.4	2.5	
	3:05 P.M.	15.0	-	2.6	
	10:30 A.M.	5.0	6.7	9.3	Grab for Lab D.O.
CLP-8	12:25 P.M.	5.0	7.2	9.4	
	1:50 P.M.	5.0	6.8	9.6	
	3:00 P.M.	5.0	8.5	9.5	Grab for Lab D.O.
	9:20 A.M.	24.0	8.2	6.3	Grab for Lab D.O.
CLP-9	11:55 A.M.	29.0	8.7	6.4	
	1:25 P.M.	27.0	8.0	7.0	
	2:25 P.M.	25.0	7.5	5.7	Grab for Lab D.O.
	9:55 A.M.	21.0	6.7	3.0	Grab for Lab D.O.
CLP-10	12:10 P.M.	21.0	6.2	2.1	
	1:35 P.M.	20.0	6.4	1.7	
	2:30 P.M.	20.0	7.0	1.4	Grab for Lab D.O.

Table C-1
Microbiological Data **
Greeley - Cache La Poudre Survey
November 16-18, 1971

Station Number	Station Description	11/16/71	11/17/71	11/18/71
CLP-6	Cache La Poudre Upstream Station	2,400* 150	2,200 300	2,200 2,200
CLP-5A	Cache La Poudre Adjacent to Island Grove Park	960 300	- -	- -
CLP-5B	Cache La Poudre at 8th Avenue Bridge	2,400 300	2,200 150	- -
CLP-5C	Cache La Poudre at 6th Avenue Bridge	- -	2,400 300	22,000 22,000
CLP-5D	Cache La Poudre at 5th Street Bridge	- -	- -	22,000 220
CLP-4	Cache La Poudre at 2nd Avenue Bridge	220,000 2,200	240,000 2,200	220,000 5,000
CLP-7	Greeley S.T.P. Chlorinated Effluent	22,000,000 22,000	2,400,000 22,000	2,200,000 22,000
CLP-3	Cache La Poudre at First Bridge Downstream of Greeley S.T.P. Eff.	2,400,000 2,400,000	150,000 22,000	220,000 220,000
CLP-2	Cache La Poudre Upstream of Great Western Effluent (Bank)	2,200,000 300,000	88,000 22,000	220,000 220,000
CLP-8	Great Western's Water Intake from Cache La Poudre River	2,200 300	2,200 300	24,000 1,500
CLP-10	Effluent from Great Western Sugar Plant	2,200,000 300,000	2,200,000 210,000	22,000,000 300,000
CLP-1	Downstream Station on Cache La Poudre Near USGS Gage	2,200,000 2,200,000	300,000 50,000	220,000 22,000

* Values in table are presented with total coliform counts (MPN) on top and fecal coliform counts (MPN) on the bottom.

** Values determined by the Colorado Department of Health.

GPO 842-882